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Inventor: Sines
Serial No. 09/364,256

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PATENT & TRADEMARK OFFICE

PATENT APPLICATION
Navy Case No. 79,955

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: E. Sines

Serial No. 09/364,256

Examiner: G. Perez

Filed: July 30, 1999

Group Art Unit: 2834

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TC 2800 MAIL ROOM

For: ELECTRICAL POWER
COOLING TECHNIQUE

AMENDMENT

Commissioner of Patents and Trademarks
Washington, DC 20231

Sir:

In response to the Examiner's Office Action dated May 26, 2000, it is respectfully requested that the following amendment in the above-identified application be entered into the record.

IN THE SPECIFICATION:

Page 1, Line 5: Delete "His" and insert -- This--.

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IN THE CLAIMS:

C1

13.(Thrice Amended) An electric motor comprising:

one or more laminations of a metallic material forming an outer casing [if] of the electric motor;

one or more circular non-metallic, flat, thermally

C1 concl'd

conductive disks placed between preselected layers of the motor laminations, said conductive disks conducting heat generated by an electrical current flowing within the motor to an edge of the conductive disk outside of the area covered by the motor laminations;

an electrically conductive material wound in a plurality of layers within the laminations so as to form an electric field that drives an armature when an electrical current is applied;

thermally conductive strips placed between preselected layers of the electrically conductive material, said thermally conductive strip extending outside of the area covered by the electrically conductive material; and

means for conducting heat at the end of the conductive disk and strips.

C2 Sub D1

14. (Twice Amended) A method for cooling electrical devices having layers of electrically conductive material wound on a core comprised of the following steps:

placing a thermally conductive [material] <u>strip</u> , having a first and a second end, capable of conducting heat from between preselected [layer] <u>layers</u> of the electrically conductive material <u>said strip extending through the layers of electrically conductive material wound on the core and</u> said first

C3 cont'd

and second end of the thermally conductive material extending outside of the area covered by the electrically conducting material; and

conducting the heat from the first and second ends of the thermally conductive material.

C3

16. (Twice Amended) A method for cooling an electrical device having layers of electrically conductive material wound on to a laminated core having a heat generating component comprising the steps of:

placing one or more <u>non-metallic, flat,</u> thermally conductive strips in contact with ~~the heat~~ generating component <u>across its entire length</u>, said thermally conductive strip extending outside of the area covered by the electrically conductive material and core and in physical <u>contact</u> with the electrically conductive material, thereby receiving heat from the heat generating component; and

removing heat from the thermally conductive strips.

[26] <u>17</u>. (Twice Amended) An electric motor, as in Claim 13, further comprising one or more thermocoolers adjacent to and touching the outer casing of the motor to conduct heat from the metallic laminations forming the outer casing of the motor.

IN THE DRAWINGS:

Figure 1 has been amended in RED to delete reference number "18" and insert the reference number --**14**--.

Figure 2 has been amended in RED to show the wording -- PRIOR ART --.

REMARKS

Claims 13 - 16 and 26 are pending in this application.

Claims 13-16 and 26 have been rejected by the Examiner.

Claim 26 has been renumbered by the Examiner as Claim 17 in accordance with Rule 1.26.

OBJECTION BY THE EXAMINER TO THE DRAWINGS:

Figure 1 has been amended in RED to delete the reference number **18** for the electrical material and insert --**14**-- the proper reference number in accordance with the specification.

Figure 2 has been amended in RED to reflect the words -- PRIOR ART --, as noted by the Examiner.

The Examiner objects to the reference number **10** being used to designate both the transformer in **Figure 1** and the windings in **Figure 4**. Review of **Figure 4** (enclosed0 does not reveal the existence of the reference number **10**, therefore no corrective action is taken.

The Examiner objects to the failure of **Figure 1** to reflect the reference number **16**. Review of **Figure 1** (enclosed) shows that reference number **16** is shown to designate the nonconductive strip in at least four places, as encircled in BLUE, therefore no corrective action is taken.

<u>OBJECTIONS BY THE EXAMINER TO THE CLAIMS:</u>

The Examiner has objected to Claims 13 because of the word "if" appearing at line 3 after "casing" should read as --of--. Claim 13 has been amended to reflect this correction.

In Claims 16 has been objected to by the Examiner because at line 3, after "physical" a word like --contact-- is needed for clarity. Claim 16 has been amended to insert the word "clarity" at the noted place.

It is respectfully submitted that this amendment removes the Examiner's objection to Claims 13, 16 and 17.

REJECTION UNDER 35 USC § 103(a)

The Examiner has rejected Claims 13 and 17 under 35 USC § 103(a) as being unpatentable over *Jarczynski* in view of *Liebe et al.* (US Patent No. 3,965,378).

The Examiner states that *Jarczynski* discloses an electric motor comprising one or more laminations of a metallic material (34) forming an outer casing of the electric motor; one or more circular thermally conductive disks (36) placed between pre-selected layers of the motor laminations, said conductive disks conducting heat generated by an electrical current flowing within the motor to an edge of the conductive disk outside of the area covered by the motor laminations; an electrically conductive material (42) wound in a plurality of layers within the laminations so as to form an electrical field that drives an armature when an electrical current is applied; and one or more thermocoolers (26) adjacent to and touching the outer casing of the motor to conduct heat from the metallic laminations forming the outer casing of the motor.

The Examiner acknowledges that *Jarczynski* does not teach or disclose thermally conductive strips placed between pre-selected layers of the electrically conductive material, said thermally conductive strip extending outside of the area covered by the

electrically conductive material.

Further, the Examiner states that *Liebe et al.* discloses thermally conductive strips (5) placed between pre-selected layers of the electrically conductive material (2), said thermally conductive strip extending outside (4) of the area covered by the electrically conductive material; and means for conducting heat at the end of the conductive strips for the purpose of improving heat transfer conditions in a coil pile,

The Examiner opines that it would have been obvious to modify the electric motor of *Jarczynski* and provide it with thermally conductive strips placed between preselected layers of the electrically conductive material; and means for conducting heat at the end of the conductive strips as disclosed by *Liebe et al.* for the purpose of improving heat transfer conditions in a coil pole.

" Thrice Amended Claim 13 reads as follows:

13.(Thrice Amended) An electric motor comprising:
one or more laminations of a metallic material forming an outer casing of the electric motor;
one or more circular non-metallic, flat, thermally conductive disks placed between preselected layers of the motor laminations, said conductive disks conducting heat generated by an electrical current flowing within the motor to an edge of the conductive disk outside of the area covered by the motor laminations;
an electrically conductive material wound in a

plurality of layers within the laminations so as to form an electric field that drives an armature when an electrical current is applied;

thermally conductive strips placed between preselected layers of the electrically conductive material, said thermally conductive strip extending

outside of the area covered by the electrically conductive material; and

means for conducting heat at the end of the conductive disk and strips.

Jarczynski teaches an electrical power generating system having a thermal collector sleeved to an electromagnetic stator core with a number of coolant fluid passages that allows a collant fluid (preferably water) to circulate within the passages and thereby remove heat conducted to the thermal collector. The composite core of the device is composed of a number of core laminations with thermally conductive laminations (e.g., aluminum or copper) interposed between preselected adjacent pairs of core laminations. Even though the thermally conductive laminations made of copper are in close proximity to the motor windings, they DO NOT go into the motor coil bundle or windings.

As recognized by the Examiner, the thermally conductive material taught by *Jarczynski* do not extend outside of the heat generating component. Further, the heat generated by *Jarczynski* is removed by the use of a specifically enumerated manner, circulated water. The critical difference between *Jarczynski* and Applicant's claimed invention is that the thermally conductive

material (in this case K1100) thermal interface provides a direct path from the interior of the motor windings directly to the outer case of the electrical device so as to cool the windings directly and minimize the mitigation of heat into the laminations of the electrical device while at the same time increasing the current density of the electrical device, thereby increasing the power density of the electrical device. **SEE**, Declaration of Dr. William Howell submitted in the parent case Serial No. 08/940,179.

Jarczynski is a system for cooling a motor stator assembly for electrical machinery. *Jarczynski* provides for preferred thermal paths through <u>motor laminations</u> to provide better heat conduction for the heat generated in the motor to dissipate. The preferred thermal paths are said to be constructed of a number of thermally conducting laminations interposed between preferred ones of the <u>core laminations</u> that form the electromagnetic <u>core</u>. These thermally conducting laminations are preferably thin metal copper sheets placed between the iron laminations of the motor, directing heat to the liquid coolant pumped through the <u>outside</u> casing of the motor. The liquid coolant then passes through a radiator to dissipate the heat and thereby cool the <u>motor laminations</u>. *Jarczynski* does not teach the entering of the windings, <u>only the laminations</u> of the motor, nor does *Jarczynski*

teach extending the thermally conducting laminations outside of the core or electrical windings of the core. In *Jarczynski* the heat in the motor electrical windings does not leave the interior of the windings.

The critical difference between *Jarczynski* and the Applicant's claimed invention is that the thermally conductive material (in this case K1100) thermal interface provides a direct path from the interior of the motor windings and laminations directly to the outer case of the electrical device so as to cool the internal windings and case directly and minimize the migration of heat while at the same time increasing the current density of the electrical device, thereby increasing the power density of the electrical device. **SEE**, Declaration of Dr. William Howell in the parent case Serial No. 08/940,179 (currently allowed)).

Liebe et al. teaches a pole coil (the definition of this term is not to be found in the patents specification and is not to be found in either the McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition, 1994, McGraw-Hill Standard Handbook for Electrical Engineers, Ninth Edition, 1957; or Fink and Christiansen, Electronics Engineering Handbook, Second Edition, 1982) of the revolving excitation windings of a

synchronous electric machine. These edgewise wound, ribbon-shaped conductors, usually copper, which are insulated from each other by interposed insulating layers. These pole coils are cooled by a gaseous coolant, usually cooling air, which flows along the lateral surfaces of the pole coil, there are provided narrow cooling fins for the purpose of increasing the heat-emitting area. The cooling fins are located at the end surfaces and/or on the side surfaces of the pole coils. The cooling fins protrude beyond the surfaces proper of the pole coil at regular spacings after one or several turns. Each cooling fin is provided at equal spacing with cuts and each of the short cooling fin sections formed is bent out to one side from its original position dividing the entire cooling into subdivisions forming short or wavey sections in the longitudinal direction deflected alternatingly so they are not lined up. This alters the formation of boundary layers. (Col. 2, Lines 32 through 62).

Liebe et al. does not specify the type of material the cooling fins are made of, however, from the tenure of the description, it may logically be assumed the fins are metallic in nature. Contra to the material claimed by the Applicant. Further, the fins in *Lieber et al.* "alter the boundary layer" and "flow-wise many short, not aligned, successive cooling fins are formed so that they are not lined up. Applicant's claimed device in Claim 16 has thermally conductive strips placed between

preselected layers of the electrically conductive material thermally conductive strip extending outside of the area covered by the electrically conductive material; and penetrate into the heart of the windings of the electric motor to remove heat from the inner reaches of the motor; the are not at "the end surfaces and/or side surfaces of the so-called "pole coil". The thermal conductive strips of the Applicant's claimed device are not fins but specific heat conductive material to remove heat and not fins designed specifically to dissipate heat as taught by *Lieber et al*.

Further, it is noted that the thermally conductive material is placed between one or more preselected laminations of a metallic material forming the <u>outer casing</u> of the electric motor, <u>not</u> between layers of the "ribbon conductors that must be insulated from each other because they are, apparently current carrying. Another major difference between the Applicant's claimed device and the cited prior art.

Therefore, it is respectfully submitted that *Jarczynski* does not teach each and every element of the Applicant's Claim 16, specifically that the thermally conductive strips go within the layers of electrically conductive material (the windings and laminations), as well as the core of any device.

Further, it is respectfully submitted that *Liebe et al.* does not teach each and every element of the Applicant's claimed device when viewed by itself or with *Jarczynski*.

The teaching of *Jarczynski* do not individually or collectively suggest or imply that the teaching of *Liebe et al.* should or could be applied to define the invention claimed by the Applicant in Claims 13. On the contrary, Applicants claimed device is for the cooling of the interior of an electrical device or motor by bringing the heat to the outside of the motor casing by thermal conductivity where the heat can be dissipated, whereas a device incorporating *Lieber et al.* only removes and dissipates the heat after it has reached the outside of the "pole coil." The device of *Lieber et al.* performs a completely different function from that claimed by the Applicant in Claim 13. Therefore, Claim 13 is allowable.

Claim 17, is a dependent of Claim 13 and as such places further limitations on Claim 13, therefore since Claim 13 is allowable, Claim 17 (as renumbered) is also allowable.

Therefore, it is respectfully submitted that the Examiner's basis of rejection of Claims under 35 USC § 103(a) has been overcome because *Jarczynski* individually or in combination with

Liebe et al. does not teach or suggested the claimed invention of the Applicant as shown in Claims 13 and 17 (as renumbered).

The Examiner has rejected Claims 14 and 16 under 35 USC § 103(a) as being unpatentable over *Liebe et al.* in view of *Herron* (US Patent No. 3,671,787).

The Examiner states that *Liebe et al.* discloses a method of cooling electrical devices having layers of electrically conductive material (2) wound on a core comprised of placing a thermally conductive material (4 and 5) having a first and second end, capable of conducting heat from between pre-selected layer of electrically conductive material said first and second end of the thermally conductive material extending outside of the area covered by the electrically conducting material (4); conducting the heat from the first and second ends of the thermally conductive material; and removing heat from the thermally conductive strips. The Examiner acknowledges that the step of placing a thermally conductive strip having a first and second end between predetermined laminations of the core, said first and second ends of the thermally conductive strip extending outside of the core.

Further, the Examiner states that *Herron* discloses the step of placing a thermally conductive strip (12) having a first and second end between predetermined laminations of the core, said first and second ends of the thermally conductive strip extending outside of the core for the purpose of improved cooling efficiency in the motor core.

Amended Claim 14 reads as follows:

> 14. (Twice Amended) A method for cooling electrical devices having layers of electrically conductive material wound on a core comprised of the following steps:
>
> placing a thermally conductive strip, having a first and a second end, capable of conducting heat from between preselected layers of the electrically conductive material said strip extending through the layers of electrically conductive material wound on the core and said first and second end of the thermally conductive material extending outside of the area covered by the electrically conducting material; and
>
> conducting the heat from the first and second ends of the thermally conductive material.

Twice amended Claim 16 reads as follows:

> 16. (Twice Amended) A method for cooling an electrical device having layers of electrically conductive material wound on to a laminated core having a heat generating component comprising the steps of:
>
> placing one or more non-metallic, flat, thermally conductive strips in contact with the heat generating component across its entire length , said thermally conductive strip extending outside of the area covered by the electrically conductive material and core and in physical contact with the electrically conductive

material, thereby receiving heat from the heat generating component; and

removing heat from the thermally conductive strips.

The foregoing discussion of *Lieber et al.* is hereby incorporated in total in regard to this basis of rejection at this point.

It is contended by the Applicant that further discussion is not needed because the Examiner's presumption as to the meaning of *Lieber et al.* is faulty because the cooling fins do not enter into the inner reaches of the laminations but merely appear at the outer edges, a major difference from the Applicant's invention claimed in Claim 16. Further, Examiner's analysis of *Lieber et al.* is flawed by the fact that *Lieber et al.* never refers to a first and second end of the cooling fins nor does *Lieber et al.* refer to the cooling fins being placed within preselected laminations.

It is noted that the Examiner failed to note that the particular element in the *Herron* device that distinguishes it totally from the claimed device of the Applicant. *Herron* relies on air having a positive pressure passing through voids or passages within the laminations to draw the heat from inside of the motor.(Col 3, Lines 39 - 42.) This teaches completely contra

to the claimed device of the Applicant which is to wick the heat out from the inside of the motor through the thermally conductive material and dissipate the heat once it reaches the outer ends of the thermally conductive material. (Col. 4, Lines 53- 57.)

Therefore, *Herron* does not tach or suggest either singly or in conjunction with *Lieber et al.* the Applicant's claimed method as set forth in Claim 14, either before or after amendment. Further, There is no teaching or suggestion in either *Lieber et al.* or *Harron* to combine the two pieces of art to reach a description of the Applicant's claimed method in Claim 16.

Claim 16, is a dependent of Claim 14 and as such places further limitations on Claim 14, therefore since Claim 14 is allowable, Claim 16 is also allowable.

Although not cited by the Examiner, Claim 15, is a dependent of Claim 14 and as such places further limitations on Claim 14, therefore since Claim 14 is allowable, Claim 15 is also allowable.

Therefore, it is respectfully submitted that the Examiner's basis of rejection of Claims 14 and 16 under 35 USC § 103(a) has been overcome because *Lieber et al.* individually or in

combination with *Herron* does not teach or suggested the claimed invention of the Applicant as shown in Claims 14 and 16.

16.

CONCLUSION

In view of the foregoing discussions, it is respectfully submitted that all of the grounds for rejection of Claims 13, 14 and 16 been overcome and that these claims are now allowable. It is therefore respectfully requested that Claims 13-17 be allowed and that this application be passed to issue with such allowed claims, an early action to that effect is courteously solicited.

Respectfully submitted,

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